

New Products

From an Old Crop

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To the values that men have always ascribed to oats have been added new products and uses. Furfural, made from oat hulls, has become a valuable solvent and chemical intermediate for refining mineral and vegetable oils. The use of oat flour as an antioxidant or stabilizer in food products is increasing rapidly. Other promising products are still in the pilot-plant stage. From the large research organizations set up by processors we can expect even better cereal products and byproducts.

Oatmeal, or rolled oats, ranks high among breakfast cereals in the United States and many European countries. It is relatively cheap and rich in protein, fat, vitamin B₁, and such minerals as phosphorus and iron.

It contains approximately 18 percent protein, 6 percent fat, 70 percent carbohydrates, and 2 percent ash, compared to 11, 2, 80, and 2 percent, respectively, of those constituents in whole-wheat cereals used as breakfast foods. Oatmeal excels in percentage of protein and fat. It has about 1,750 calories to the pound; whole-wheat cereals have about 1,680 calories.

Oatmeal, as steel-cut or Scotch oats, was first packaged for the market in glass jars by Ferdinand Schumacher of Akron, Ohio, in 1854. Later it was packed and shipped in wooden barrels to the local grocer, who weighed and sold it by the pound. The whole groat (kernel) or cut pieces of the groat

(granulated oats) apparently were not flaked or rolled until late in the nineteenth century. The term "rolled oats" then replaced the term "oatmeal" to some extent, and for reasons of sanitation and better merchandizing the product was packed in small cardboard cartons.

The original rolled oats formed comparatively thick flakes. Each flake was rolled from a single oat groat (a kernel with all the hulls removed). A quicker-cooking flake is thinner; it is rolled from groats cut into about three pieces. Still quicker-cooking flakes, relatively new on the market, are rolled very thin. All three have the same food value.

IN THE MILLING of oatmeal, the oats are cleaned, dried, and toasted to make the hulls more brittle so they can be removed more easily by the hulling stones. The toasting also develops a good flavor in the groat, which is carried to the final product. The next step is the separation of the oat grains into grades, or sizes, on the basis of length and diameter. The processes of hulling, separation of the unhulled oats from the groats, steaming, cutting, rolling the groats into flakes, and packaging follow in order.

Milling percentage, or extraction, varies rather widely, depending almost entirely on the quality of the grain. The heavier, plumper, and cleaner commercial oats give the highest extraction of rolled oats. The skill of the millwrights in dressing and adjusting the hulling stones, as well as in operating numerous accessory machines, contributes much to the yield and quality of rolled oats.

About 13.5 bushels, or 432 pounds, of medium-good to excellent oats produce a barrel of high-grade rolled oats. The standard barrel for rolled oats or

oat groats is 180 pounds; for ground oatmeal of steel-cut oats it is 196 pounds. Following the distribution of improved disease-resistant varieties with higher test or bushel weight, a higher milling yield of rolled oats is being obtained. Certain new varieties, such as Clinton, Benton, and Bonda, with large groats and relatively thin hulls, are outstanding in milling value.

Food products might be made from oats gathered in the milk stage if a method could be developed for extracting the milk. The active nutritive principle found in coconut milk and corn in the milk stage might also be found in the developing oat groat.

OAT FLOUR contains an antioxidant that is used to preserve the quality by delaying the development of rancidity in fat-containing foods. It is used in several ways: Thoroughly mixed or infused with lard, margarine, and peanut butter; dusted or coated on potato chips or salted nuts; in the coating of paper or other containers of foodstuffs, such as lard, bacon, and coffee.

As much as 10 percent of oat flour may be coated on or incorporated in paper of various types.

Special grades of oat flour are marketed under the name Avenex for use as a preservative of food products. Avenex also is used as an antioxidant or stabilizer in the preservation of milk, ice cream, other dairy products, fish fillets, fish oils, other fishery products, meat and meat products, candies, powdered egg yolk, peanut butter, piecrust mixes, and doughnut flours. Cereal extracts protect the flavor of butter and retard the development of oxidized and tallowy off-flavors.

During the Second World War, oat flour was included in special candy bars used in an Army emergency ration to keep them from freezing or melting in storage, in transit, or on the battlefield.

Oat gum, a fraction of the oat grain, has excellent possibilities for use as a stabilizer in ice cream. It imparts a desirable texture to the mix and to

the finished ice cream. It also has antioxidant properties and retards oxidation of ice cream in storage. Oat gum compares favorably with other stabilizers, such as gelatin, gels made from psyllium seed, and alginates made from seaweeds, for ice-cream mixes and finished ice cream. It also improves the keeping qualities of pork products.

The total consumption of oats for the manufacture of antioxidants and stabilizers is relatively small, despite the numerous uses.

OATMEAL HAS BEEN USED separately or with soaps for reducing skin blemishes and alleviating rashes and sunburns. Although we cannot confirm these assumed beneficial effects, the belief has long prevailed that oatmeal has some virtue as a skin conditioner. A good many soaps contain oatmeal. Oat flour has marked power as a detergent or cleansing agent.

The oat gum mentioned earlier is used as a mild detergent. It is put into the bath water to treat certain skin diseases—a replacement for the oatmeal bag of our grandmother's day.

OAT HULLS, in the diet of poultry, serve chiefly as a preventive against slip tendons and also for the development of feathering. They contain a dietary corrective property that checks cannibalism and feather picking in chickens. Oat hulls also are rich in manganese. Thus oats are a popular ingredient in poultry rations. About as much oat grain is now fed to domestic fowls as was fed to horses in the days before the automobile and tractor.

FURFURAL is the most important product made from oat hulls, a by-product of the milling of rolled oats. About 4 percent of our national crop of oats goes into the making of rolled oats and oat flours. Thus 50,000,000 bushels, or 800,000 tons, of oats yield approximately 27 percent, or 210,000 tons, of oat hulls. About 235 bushels of oats, weighing 32 pounds to the bushel,

produce a ton of oat hulls, or 200 pounds of furfural.

The most important uses for furfural are in oil refining, the purification of wood rosin, and the production of synthetic resins such as bakelite.

A few pharmaceutical products have been synthesized from furan resins, which are made from oat hulls. These include Furfurmethide, a quaternary ammonium furan compound (furfuryltrimethylammonium iodide), Furfuracin (5-nitrofurfuralsemicarbazone), an antiseptic and possible supplement for penicillin or streptomycin, and other products that may serve as substitutes for novocain and sulfanilamide. Furan compounds have a wide variety of possible medical applications.

Each threshed grain of oats bears two integuments (hulls), the lemma and palea, which enclose the groat. In processing rolled oats, the hulls are removed by milling stones. Oat hulls have little feed value. They are poor in actual nutrients and low in digestibility. Ground oat hulls, however, have some nutritive value in mixed feeds. They contain about 4 percent protein, 1.5 percent fat, 29 percent fiber, 52 percent nitrogen-free extract, and 6 percent ash.

Oat hulls are rich in pentosans, from which furfural is derived. Before the manufacture of furfural, the hulls were used only for fuel or packing. In making furfural, the oat hulls are subjected to destructive distillation—that is, they are pressure-cooked with weak acids. After that comes a complicated purification process. Furfural (furfuraldehyde) is a high-boiling, tan, transparent liquid, with a faint bitter-almond odor, closely related to formaldehyde. Furfural can be made from cornstalks and corncobs, bagasse, rice hulls, and many other waste products, but few of them give as high yields of furfural as do oat hulls. Corncobs are the only present source of furfural other than oat hulls.

According to Fredus N. Peters, Jr., vice president of Research Laboratories, furfural was first manufactured

commercially in the Cedar Rapids, Iowa, plant of the Quaker Oats Co. It was developed by H. J. Brownlee and Carl S. Miner. The first drum of furfural was shipped in 1922, the first railroad tank car in 1927. In 1947 furfural was shipped in a tank steamer.

Early uses of furfural were as a fungicide for seed treatment, a preservative for glue, a fumigant for poultry houses, a repellent for screwworm flies, and an embalming fluid. It also was used as a paint and varnish remover, for control of slime deposits in water supplies, as a remover of carbon from gasoline motors, and as a fungicide in the form of hydrofuranamide to control the infection known as athlete's foot. It likewise was used early as a solvent for plastics.

Since 1936, the use of furfural has gone up spectacularly, especially as a selective solvent in petroleum and vegetable-oil refining, and in the manufacture of furan resins. One of the most recent uses for furfural has been for chemical intermediates, such as furan, tetrahydrofurfuryl alcohol, methyltetrahydrofuran, and dihydropyran.

According to H. H. Gross, of the Texaco Development Corp., of New York, the furfural-refining process licensed by his firm is one of the most widely used processes in the world for processing lubricating oils. In 1948, 20 furfural-refining units had been installed and 13 others were under contract for construction. The units can handle 60 to 6,000 barrels of charge oil a day. The furfural-refining process also is used for refining gas oils to produce premium grades of Diesel fuel of improved cetane number and heating oils with improved burning properties.

The use of furfural as a raw material for the manufacture of adiponitrile, a nylon intermediate, was announced in 1947. Dr. Oliver W. Cass, research supervisor of the Niagara Falls laboratories of the E. I. du Pont de Nemours & Co., described the making of nylon and nylon yarns thus: ". . . A most exacting and complicated processing, which includes reactions of fur-

fural with steam, gases, and various other chemicals. The result is adiponitrile. This is further processed into hexamethylene diamine . . . and then reacted with adipic acid to produce nylon 'salt,' which looks like table salt. . . ." To facilitate its handling, the "salt" is dissolved in water and transported in tank cars to plants for further processing. It is then spun into yarn for clothing and flaked for plastics.

In recent years, oats have been clipped in the early, succulent-growth stages—3 to 4 weeks after the plants emerge—for processing into highly nutritive "green-grass products" as feed for animals and pellets for man. Those products are high in chlorophyll, protein, vitamins (particularly carotene and vitamin K), and other desirable food elements. They are available

on the market. Wheat, barley, and rye have proved as good as, or even better than, oats for clipping under most conditions. The rye grasses are superior to any of the cereals because they recover more quickly after clipping. Consequently, the utilization of oats for this purpose has been limited.

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HOME DRYING OF FRUITS is a simple and practical method of preservation which consists in the removal of moisture by heat and air circulation. This results in the concentration of the fruit ingredients and prevents spoilage in storage.

The drying may be accomplished by sun drying or with the use of artificial heat. The former has limitations because it depends on weather conditions. The latter is more practical because the drying is under control.

The kitchen oven makes a simple, convenient drier. The only additional equipment required are drying trays and a thermometer.

After preparation, the ripe, sound sliced fruit is spread evenly on wooden slat trays or cloth-covered wooden frames and placed in the oven, which is adjusted so that the top tray is about 150° F. The oven door should be propped open several inches at the top to permit rapid drying. The drying period extends over a period of 6 to 12 hours, depending upon the oven, product, etc. Twelve pounds of sliced fruit (1 peck) such as apples, peaches, or pears will usually dry down to 1½ pounds of dry material, which will fill three pint jars. Glass jars are excellent containers because they may be tightly sealed against moisture gain or loss and insect infestation. The jars should be stored in a cool place.

Color and flavor are sometimes impaired during drying unless the fruit is previously treated with sulfur fumes, steamed, or dipped in salt water. For detailed information on processing, construction of home-made cabinet driers, and other details, see U. S. D. A. Farmers' Bulletins Numbers 984 and 1918 or AWI-59. If copies are not in print, they may be read in comprehensive city or university libraries.—William Rabak, Western Regional Research Laboratory.